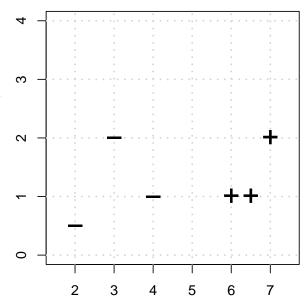
## Exercise 1: Hard Margin Classifier

The primal optimization problem for the two-class hard margin SVM classification is given by

$$\begin{aligned} & \min_{\boldsymbol{\theta}, \theta_0} & & \frac{1}{2} ||\boldsymbol{\theta}||^2 \\ & \text{s.t.} : & & y^{(i)} \left( \left\langle \boldsymbol{\theta}, \mathbf{x}^{(i)} \right\rangle + \theta_0 \right) \geq 1 \end{aligned}$$



- (a) Calculate the following quantities:
  - γ
  - $\bullet \| \boldsymbol{\theta} \|$
  - $\bullet$   $\theta$
  - $\theta_0$
  - Determine which points are support vectors.

(b) Calculate the quantities in (a) after applying the following changes:
• All points are rotated by 45 degrees counterclockwise.
• All points are shifted by 2 to the right (in the x-axis).
• One SV moves closer to the separating hyperplane $(6,1) \rightarrow (5.5,1)$

 $\bullet$  One SV (6,1) is removed from the dataset.